

### Scientific Inquiry

**PS-1 The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.**

**PS-1.2 Use appropriate laboratory apparatuses, technology, and techniques safely and accurately when conducting a scientific investigation.**

**Taxonomy Level:** 3.1-C Apply Procedural Knowledge

**Key Concepts:** laboratory apparatus, laboratory technology, laboratory techniques, scientific investigation

**Previous/Future knowledge:** Students were introduced to this topic with specific tools identified at each grade level as follows: (K-1.2) magnifiers and eyedroppers; (1-1.2) rulers; (2-1.2) thermometers, rain gauges, balances, measuring cups; (3-1.5) beakers, meter tapes and sticks, forceps/tweezers, tuning forks, graduated cylinders, graduated syringes; (4-1.2) compass, anemometer, mirrors, prism; (5-1.4) timing device and 10x magnifier; (6-1.1) spring scale, beam balance, barometer, sling psychrometer; (7-1.1) microscope; (8-1.6) convex lenses, plane mirrors, color filters, prisms, slinky springs. With more complex scientific investigations, many more tools will be used in Physical Science. Using technology while conducting scientific investigations and specific laboratory techniques will also be an important component of Physical Science developing laboratory skills essential for the study of Biology, Chemistry, and Physics.

#### It is essential for students to

- Use appropriately and identify the following laboratory apparatuses and materials:

Apparatuses and materials appropriate for chemistry investigations of Physical Science:

Balances, triple beam or electronic	Pipettes / droppers
Beakers	pH paper / pH meters
Burners (Bunsen), flint strikers	Ring stand, ring clamp, and test tube clamp
Chemical scoop	Stirring rods
Conductivity apparatus (light bulb)	Stoppers – rubber, cork
Erlenmeyer flasks	Test tubes, holder, and rack
Evaporating dishes	Test tube brushes
Filter paper	Thermometers (alcohol, digital)
Forceps	Tongs (crucible, beaker)
Funnels	Watch glasses
Graduated cylinders	Wire gauze with ceramic centers
Hot plates	Wood splints
Litmus paper	

Apparatuses and materials appropriate for physics investigations of Physical Science:

Ammeters and voltmeters (or multimeters)	Motion carts (or toy cars)
Compasses	Motors, simple electric
Diffraction grating	Protractors
Dry cells (or other voltage source)	Resistors
Electroscopes	Slinky springs
Flashlights	Spectroscope
Generators (hand-held)	Spring scales
Hand lenses (magnifiers)	Switches, knife
Lenses (convex and concave)	Timers
Light bulb and holders	Tuning forks
Magnets	Weights
Mirrors, plane rectangular	Wire, insulated copper
Measuring tools: Metric rulers, Meter sticks, and meter tapes	

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**PS-1 The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.**

- Use the identified laboratory apparatuses in an investigation safely and accurately with
  - Associated technology, such as
    - computers, calculators and other devices, for data collection, graphing, and analyzing data, or
    - probeware and meters to gather data; and
  - Appropriate techniques that are useful for understanding chemistry and physics concepts, such as
    - measuring, heating, filtering, timing, and
    - setting up circuits, electrostatics, or
    - wave behavior.

**NOTE TO TEACHER:** Other useful materials and apparatuses to support the standards include

Chemicals as needed for planned labs

Computers with access to the Internet

Laser

Microscale supplies where appropriate

Molecular models

Ripple tank

Static electricity materials: plastic and glass rods; wool, fur, and silk fabric; pith balls

Supports, lenses, screen, meter sticks (for simple optical benches)

Tripod lens

Vacuum pump, bell jar, and bell

Van de Graaf generator

Wire cutters

#### It is not essential for students to

- Cut or bend glass tubing or insert it in rubber stoppers;
- Understand how probeware from a specific manufacturer functions.

#### Assessment Guidelines:

The objective of this indicator is to *use* appropriate laboratory apparatuses, technology, and techniques safely and accurately, therefore the primary focus of assessments should be to determine the proper use of the apparatuses, technology, and techniques for scientific investigations. Students must show an understanding of how the apparatuses are used safely and accurately.

In addition to *use*, assessments may require that students:

- *Identify* an apparatus from a description or illustration;
- *Recognize* appropriate laboratory apparatuses, technology, and techniques for given procedures;
- *Recognize* safety guidelines associated with use of laboratory apparatuses, technology, and techniques;
- *Exemplify* appropriate apparatuses, technology, and techniques needed for a scientific investigation;
- *Infer* which laboratory apparatuses, technology, and techniques are appropriate for given procedures and that will produce accurate results.